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Takahashi et al.

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(54) **IMAGE READER, IMAGE FORMING DEVICE, AND BEARING RETAINING STRUCTURE**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**[7] **G03G 15/04**
(52) **U.S. Cl.** **399/211**
(58) **Field of Search** 399/211, 107, 399/117

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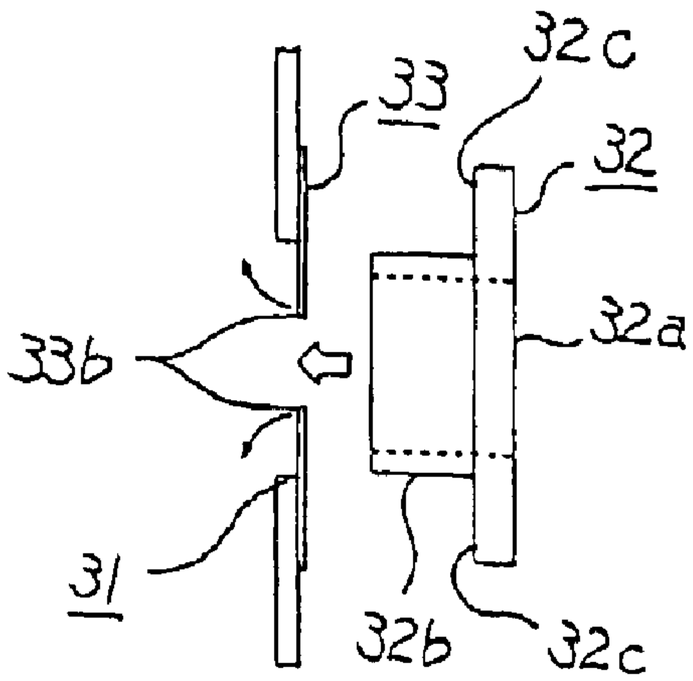
(57) **ABSTRACT**

A drive shaft, which is driven by a drive motor, is held firmly at two points by bearing structures. The bearing structure has a hole in which a bearing member is fit. The bearing member has hole, which is concentric with respect to the hole in which the bearing member is fit. A crimp, which is made of elastic material, having interfering portions that interfere with the bearing member is provided between the bearing member and the hole in the bearing structure in which the bearing member is fit.

23 Claims, 5 Drawing Sheets



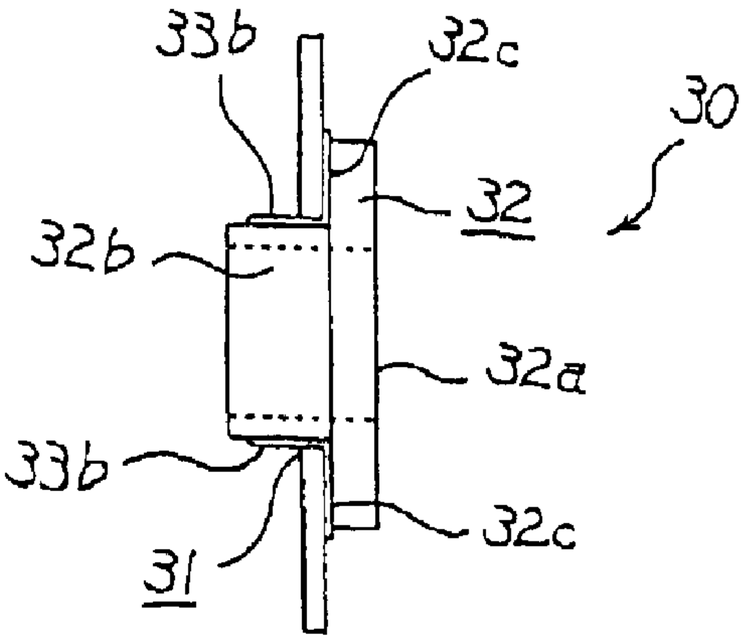


FIG. 1

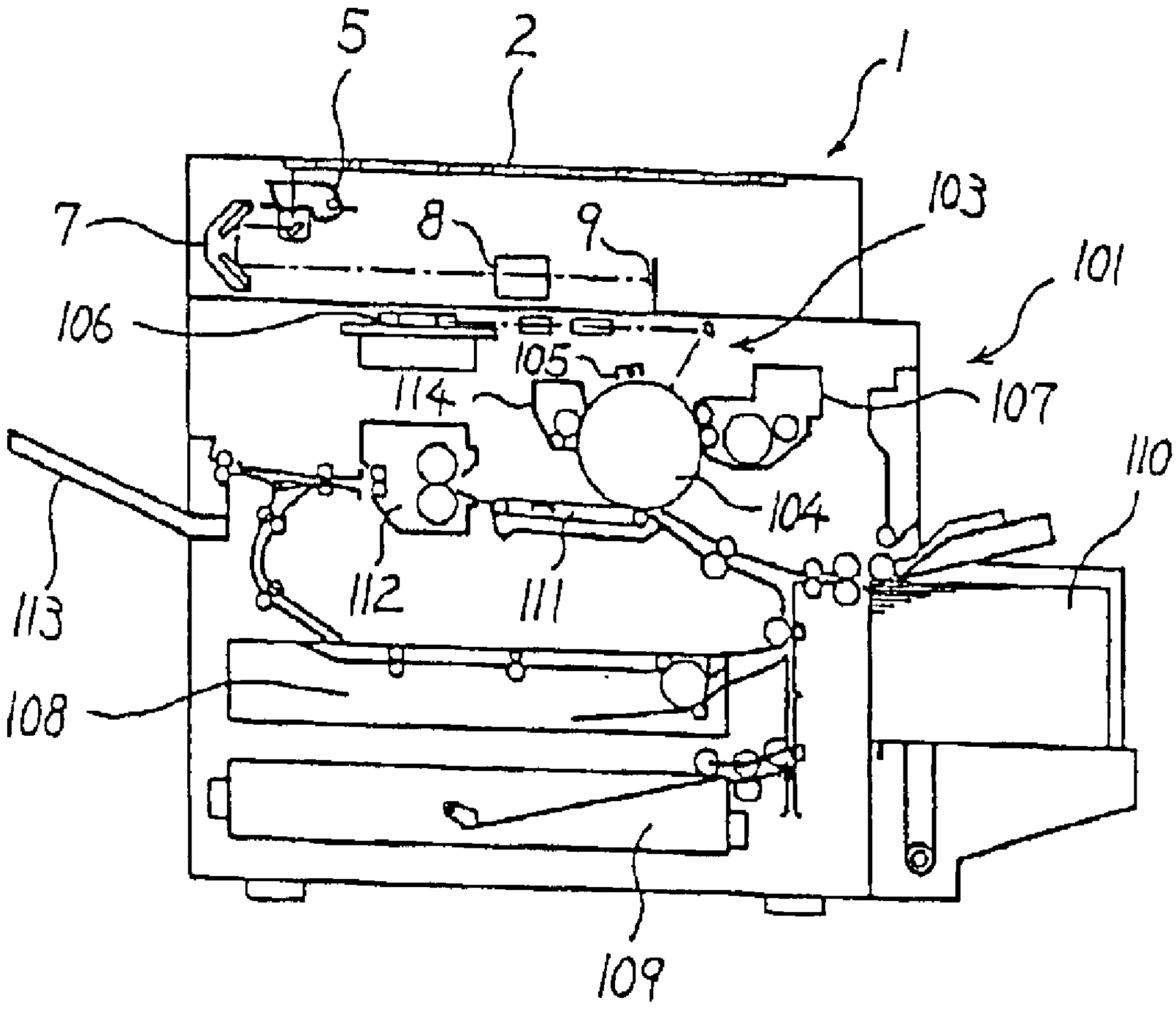
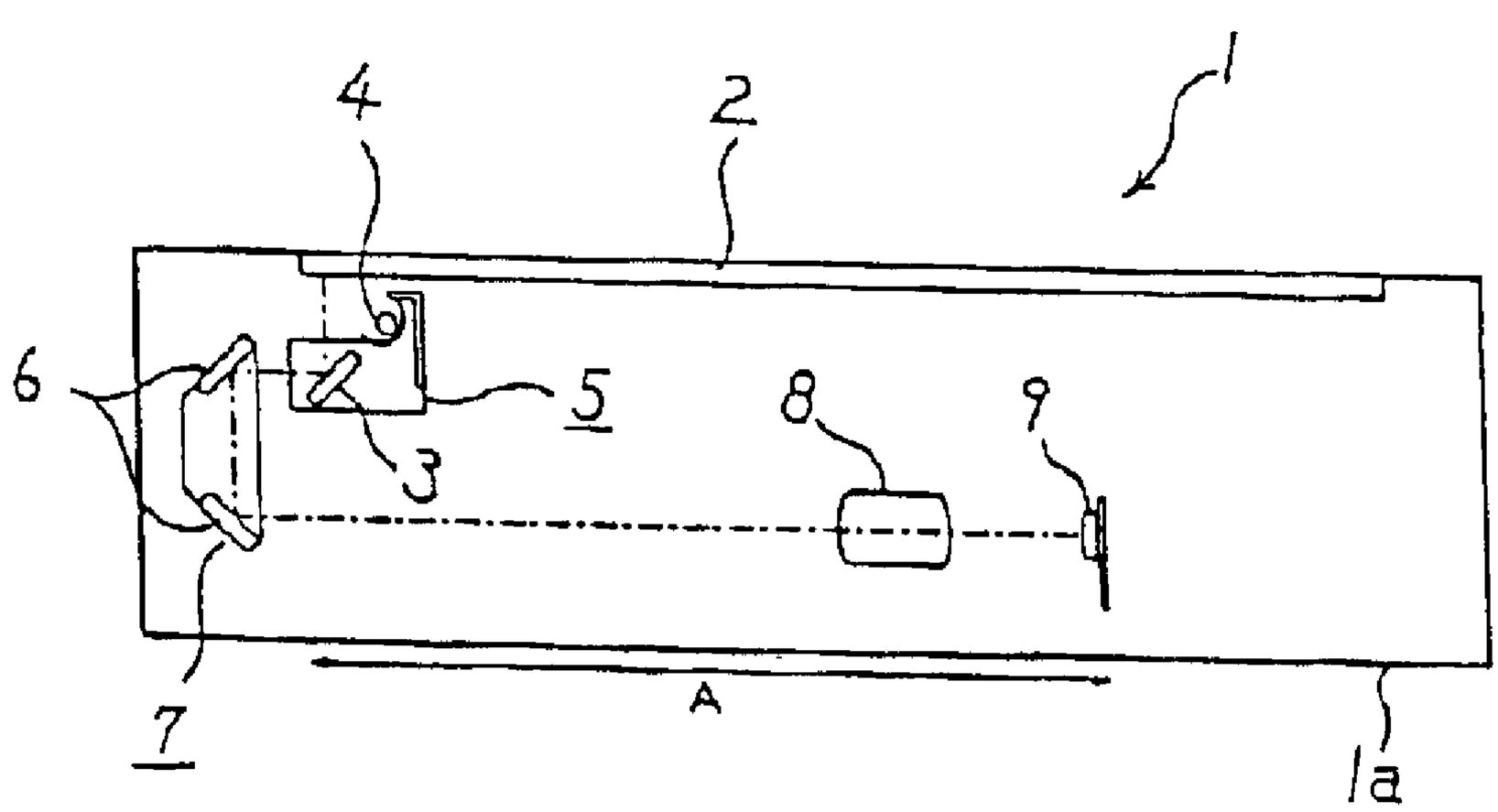

5
2
1
7
8
9
103
101
106
105
114
107
110
104
113
112
111
108
109

FIG. 2


4
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1
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5
8
9
3
7
A
1a

FIG. 3

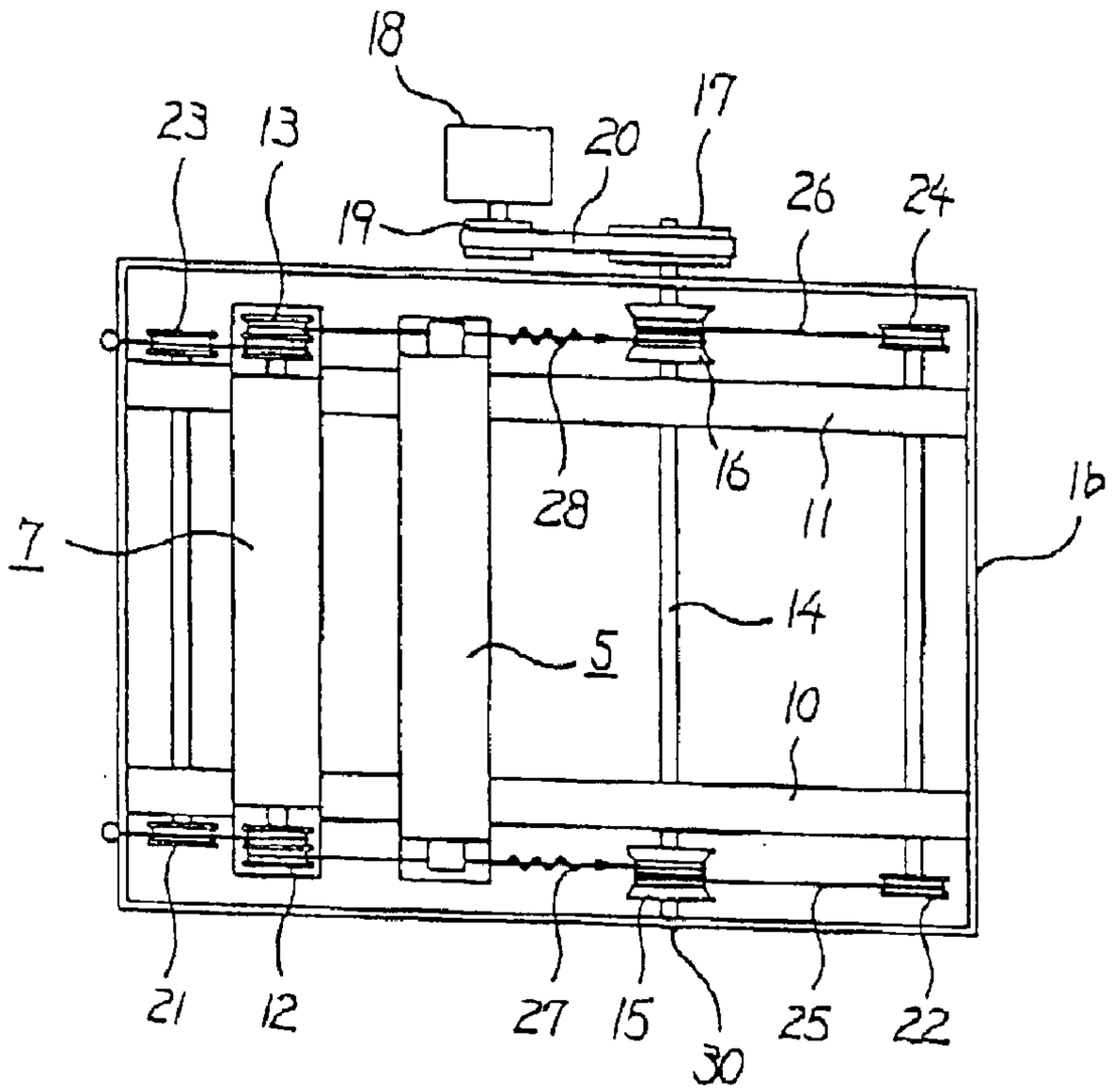


FIG. 4

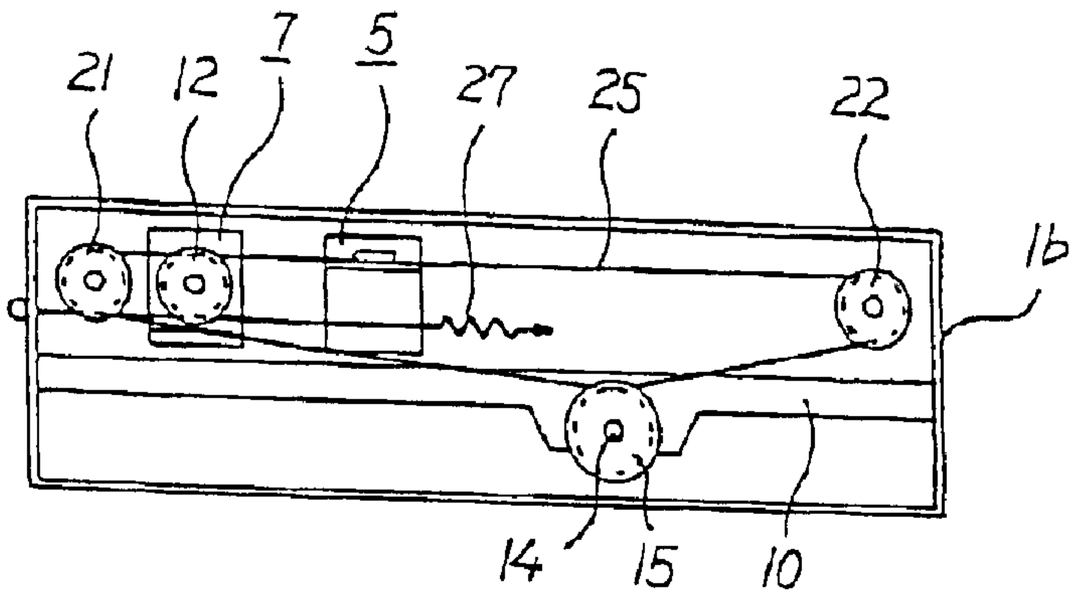
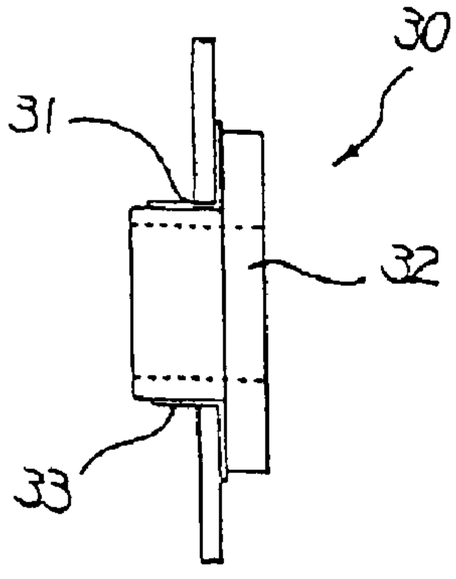


FIG. 5



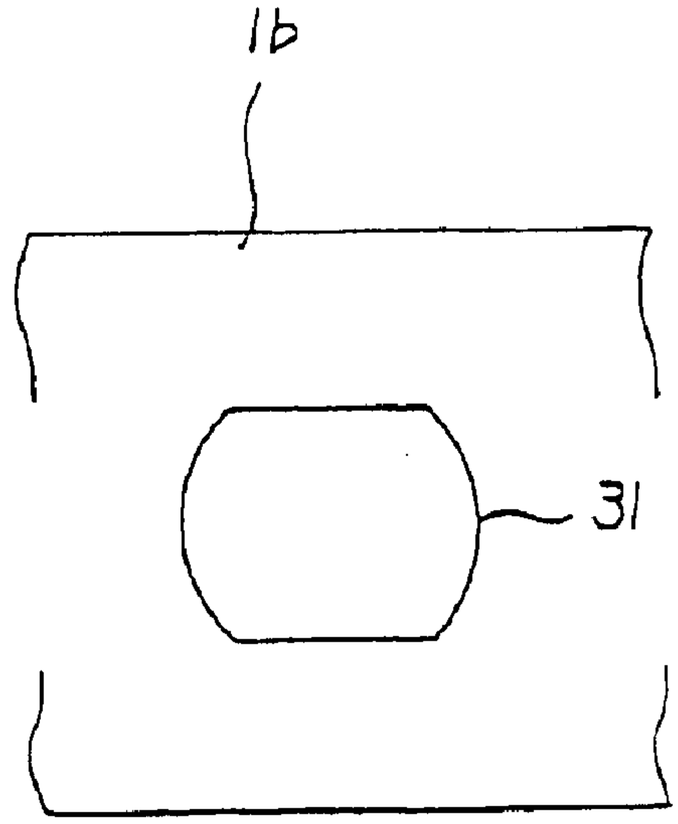


FIG. 6

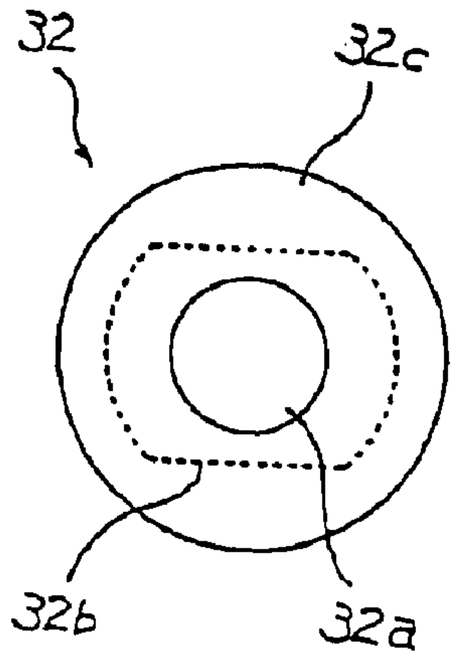


FIG. 7A

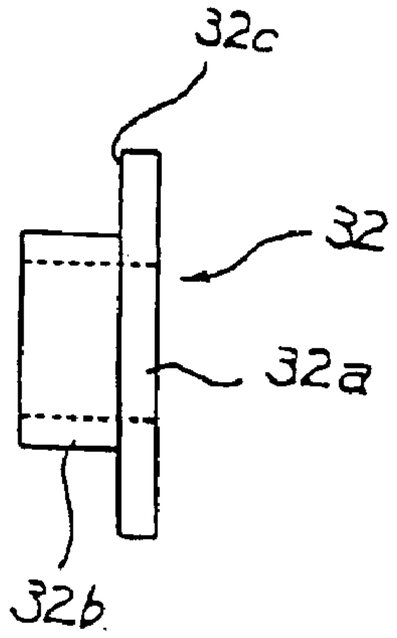


FIG. 7B

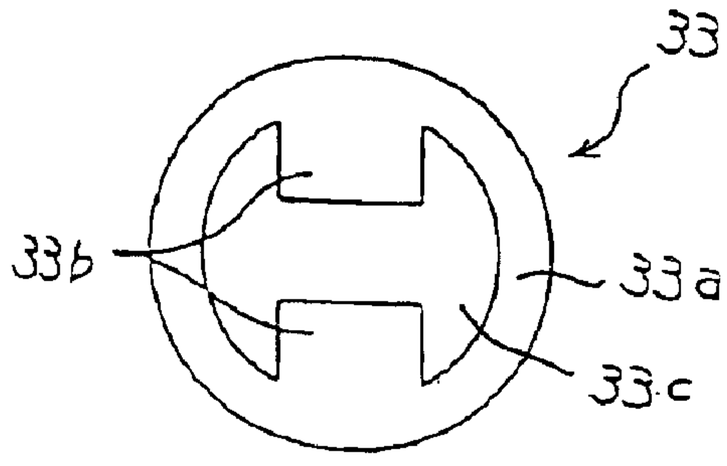


FIG. 8

FIG. 9A

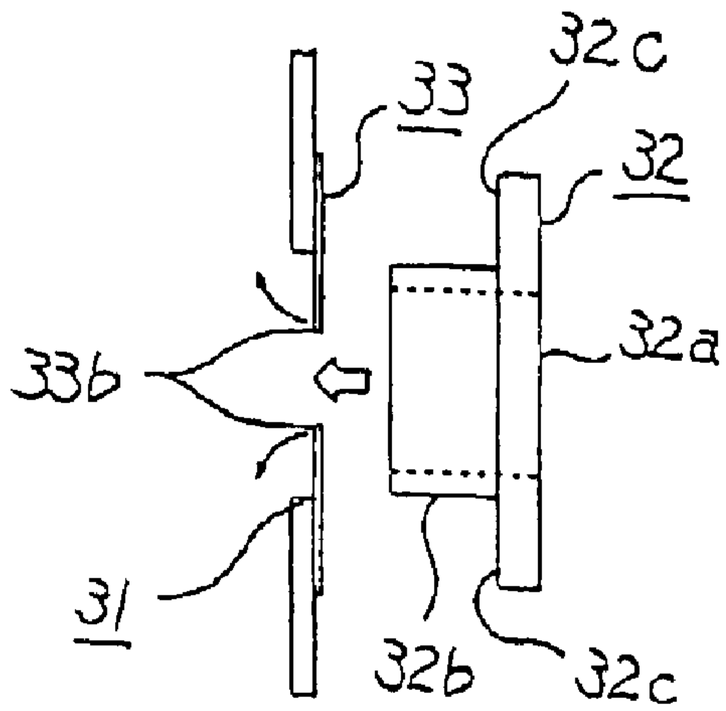


FIG. 9B

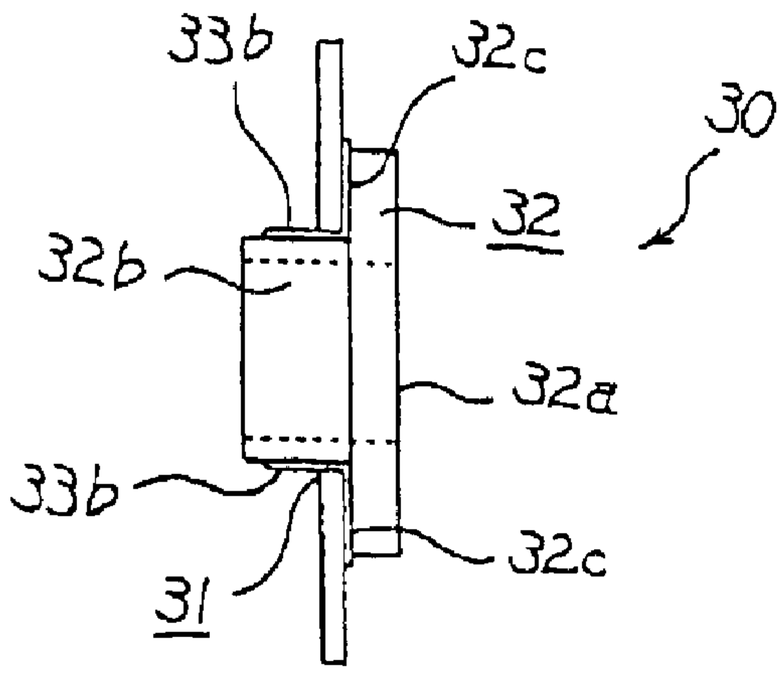


FIG. 10

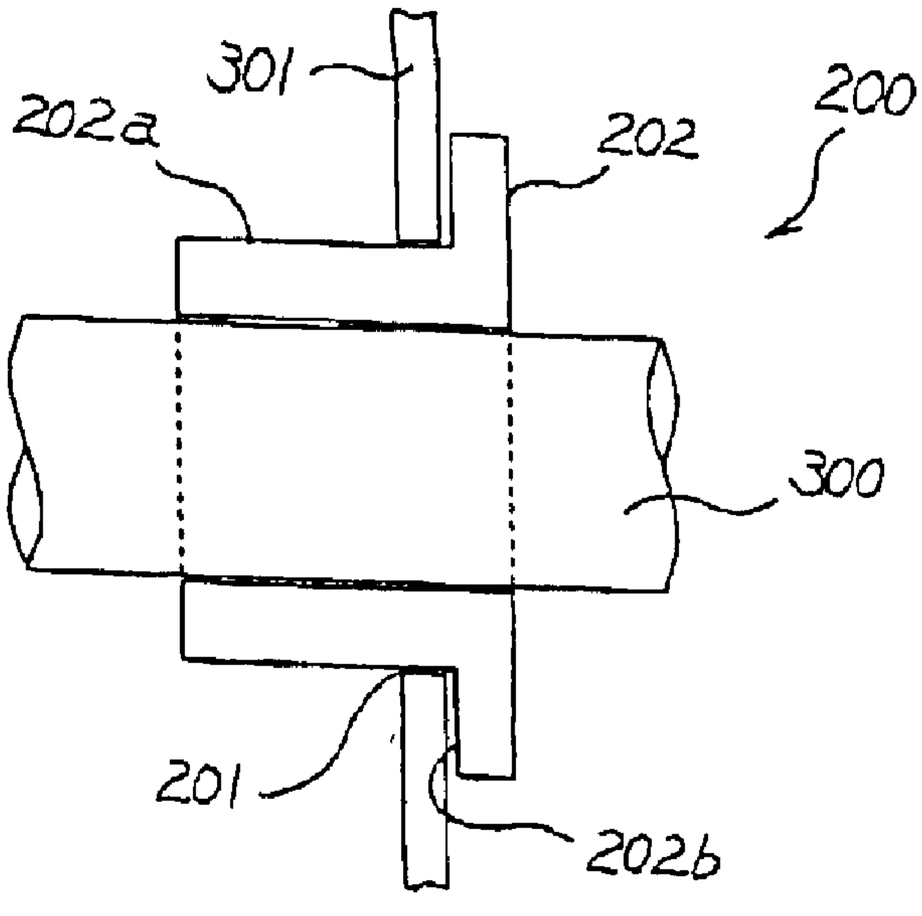


FIG. 11A

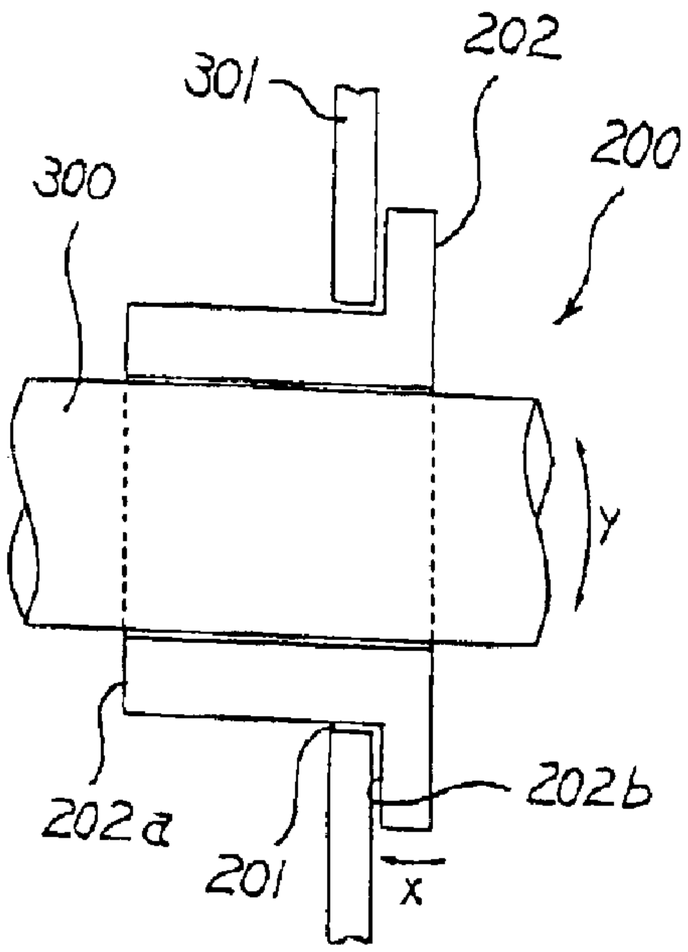


FIG. 11B

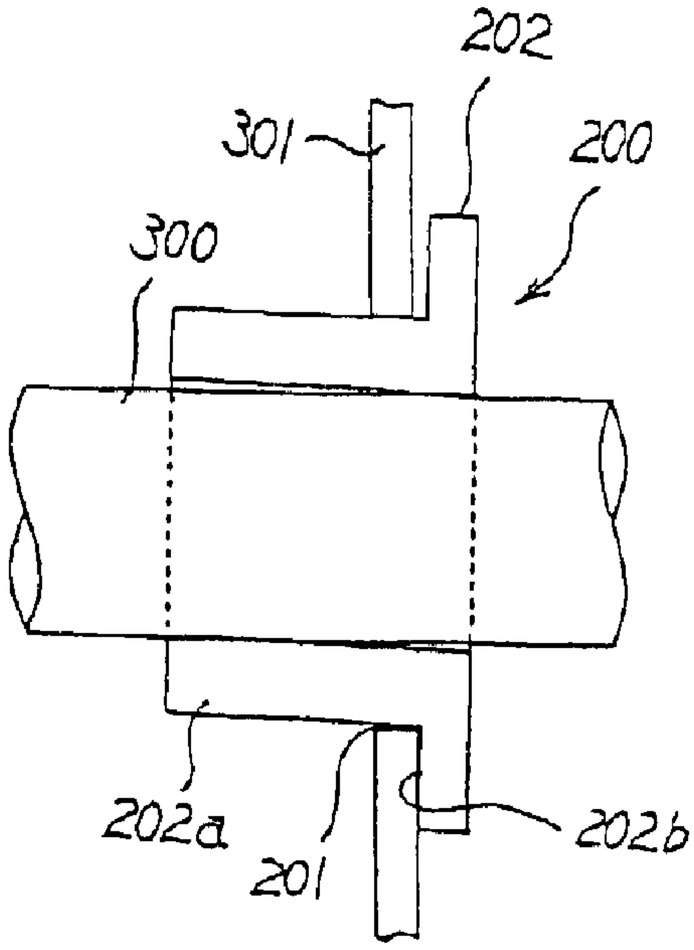


IMAGE READER, IMAGE FORMING DEVICE, AND BEARING RETAINING STRUCTURE

BACKGROUND OF THE INVENTION

1) Field of the Invention

The present invention relates to the bearing structure for the drive mechanism, image reader and image forming device equipped with the image reader.

2) Description of the Related Art

An image reader that scans a surface of a paper (copy surface) and outputs (prints) an image of the copy surface as image data is widely known. In such image readers, a luminous source or a mirror is mounted on the moving body which freely carries out linear reciprocating motion under the contact glass. The light from the illuminant light source is directed on to the copy surface for illuminating it while the moving body is shifted in the secondary (sub) scanning direction along the copy surface mounted onto the contact glass. The light reflected from the copy surface, for every line in the main scanning direction is focused on a charge coupled device (CCD) and made to form an image.

A stepping motor is used to move the moving body. The driving force of the stepping motor is transmitted to a wire pulley (or a gear) provided on a drive shaft. A wire fixed to the moving body is wound around the wire pulley. Thus, when the stepping motor is driven, the moving body performs the reciprocating motion.

In the conventional image forming device, the drive shaft is such that the wire pulley is fixed to one end whereas the other end is inserted into the bearing fitted in a frame of the image forming device.

FIG. **10** shows a schematic longitudinal side view of the bearing section **200** into which the other end of the drive-shaft **300** is inserted. The bearing section **200** is composed of bearing hole **201** and bearing **202**. The bearing hole **201** is made by cutting a notch in the frame **301** of the image reader. The bearing **202** has a flange **202***b* on one end of the bearing main body **202***a*. This flange **202***b* is made cylindrical in shape to enable the insertion of the drive shaft **300**. The bearing section **200** is formed by inserting the bearing main body **202***a* of the bearing **202** into the bearing hole **201** and pressing the flange **202***b* against the frame body **301**, thereafter, the drive shaft **300** is inserted into the bearing main body **202***a* of the bearing **202**.

However the bearing section **200** has following problems. For example, if the gap between the bearing hole **201** and the bearing **202** is larger as shown in FIG. **11**(*a*), the drive shaft **300** rattles in axial direction (i.e., X-axis) and radial direction (i.e., Y-axis). This rattle of the drive shaft **300** causes impulsive sound at the time of start up and stop as well as noise during the normal running due to the load while driving.

If the bearing **202** is press-fitted with respect to the bearing hole **201** as shown in FIG. **11**(*b*), the bearing **202** might get tilted with respect to the bearing hole **201**. If the bearing **202** gets tilted then the desired positioning accuracy of the bearing **202** with respect to the drive shaft **300** can not be achieved. If the bearing **202** can not be positioned accurately with respect to the drive shaft **300**, a load is exerted on the drive shaft **300** resulting in lower driving efficiency (driving performance decrement) and lesser durability.

SUMMARY OF THE INVENTION

It is an object of this invention to provide the image forming device, image reader, and a bearing structure for the drive mechanism in the image forming device, which can prevent the decline in driving efficiency, decline in durability, impulsive sound at the time of start up and stop and noise during the normal operation by preventing the rattle of the bearing inserted into the bearing hole.

The bearing structure for a drive mechanism according to one aspect of the present invention comprises a first hole in a frame; a bearing member that is fit into the first hole, the bearing member having a second hole for inserting a drive shaft that is driven by a drive motor; and a crimp provided between the bearing member and the first hole, which crimps the bearing member in the first hole.

The image reader according to another aspect of the present invention employs the bearing structure according to the present invention.

The image forming device according to still another aspect of the present invention employs the bearing structure according to the present invention.

These and other objects, features and advantages of the present invention are specifically set forth in or will become apparent from the following detailed descriptions of the invention when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic longitudinal front view, showing the internal structure of image forming device with the image reader mounted on it, according to an embodiment of the present invention.

FIG. **2** is a schematic longitudinal front view of the structure of the image reader.

FIG. **3** is a top view of the mechanism for movement of the first and second carriages in the secondary scanning direction.

FIG. **4** is a front view of the mechanism for movement of the first and second carriages in the secondary scanning direction.

FIG. **5** is a longitudinal side view of a bearing structure according to the embodiment of the present invention.

FIG. **6** is a front view of a bearing hole in the bearing structure.

FIG. **7**A is a front and FIG. **7**B is a side view of the bearing.

FIG. **8** is a front view of the crimping member according to the embodiment of the present invention.

FIG. **9**A is a side view that shows the condition prior to inserting the bearing into the bearing hole, and FIG. **9**B is a side view showing the condition after inserting the bearing into the bearing hole.

FIG. **10** is a schematic longitudinal side view of a conventional bearing structure.

FIG. **11**A and FIG. **11**B are for explaining the problems in the conventional bearing structure.

DETAILED DESCRIPTIONS

Embodiments of the present invention are explained below with reference to the accompanying FIG. **1** to FIG. **9**. A digital copier is taken as an example of the image forming device, moreover, the scanner in the digital copier is taken as an example of the image reader for the sake of explanation.

FIG. **1** shows schematically the longitudinal front view of an internal structure of an image forming device **101** with an

image reader **1** mounted on it, according to an embodiment of the present invention. The configuration of an image formation section **103**, which outputs the image electrophotographically, of the image forming device **101** is widely known. Therefore, the configuration of the image formation section **103** will be explained only briefly.

In the image formation section **103**, the periphery (outer side) of a photoelectric body **104** is charged evenly by a charger **105**. Electrostatic latent image is inscribed on the charged part of the photo electric body **104** by a photo inscribing unit **106** based on the image data of the copy paper read by the image reader **1**. This electrostatic latent image is developed by a processing device (development counter) **107** and the developed image on the photo electric body **104** is transferred by a transferring belt **111** on to the paper fed by any of paper feeding sections **108**, **109**, or **110**. The paper is then forwarded to a fixing device **112** and is discharged into a discharge tray **113** after the transferred image is fixed on it. The toner that remains on photoelectric body **104** is cleaned by a cleaning unit **114**. Thus, the image formation device becomes ready for preparing the next image.

Configuration of the image reader **1** will be explained now. FIG. **2** shows schematically the longitudinal front view of structure of the image reader **1**. A contact glass **2** is provided, above a tray **1***a* of the image reader **1**, for mounting the copy paper (not shown in the figure). A first carriage **5**, with a reflecting mirror **3** and an illuminating lamp (Xe lamp) **4** mounted on it, is placed in the position facing the contact glass **2** from below. The first carriage **5** is positioned such that it can move freely in secondary scanning direction shown by an arrow A. A second carriage **7** which reflects the optical path of the rays reflected by two reflecting mirrors **6**, is positioned in the optical path of reflection of the first carriage **5** in such a way that it can move freely in the secondary scanning direction. A charge couple device (CCD) **9**, which is an image sensor, and an image forming lens **8** are positioned in the optical path of the light reflected by the second carriage **7**. The reflecting mirror **3** and the illuminating lamp **4** mounted on the first carriage **5**, and the two reflecting mirrors **6** mounted on the second carriage **7**, form the respective optical reading systems. A pressure plate (not shown in the figure) holds the copy papers mounted on to the contact glass **2**.

The mechanism that realizes the movement of the first carriage **5** and second carriage **7** in the secondary scanning direction will be explained with reference to FIG. **3** and FIG. **4**. FIG. **3** shows a top view and FIG. **4** shows a side view of this mechanism. The image reader **1** has frame **1***b* inside of the tray **1***a*. There are two parallel rails **10** and **11** in this frame **1***b*. The rails **10** and **11** support two freely sliding carriages **5** and **7** that are placed longitudinally at right angle to rails **10** and **11**. Double grooved pulleys **12** and **13** are provided on two ends of the secondary carriage **7**.

A drive shaft **14** is positioned under the rails **10** and **11** at right angles to the rails **10** and **11**. Wire pulleys **15** and **16** are positioned between the side surface of frame **1***b* and rails **10** and **11** respectively of the drive shaft **14**. One end of the drive shaft **14** is protruding out from the frame **1***b* and a pulley **17** is fixed on this protruding end. A belt **20** is wound on pulley **17** to transmit the driving force from a pulley **19** connected to a drive shaft of a stepping motor **18**. The other end of the drive shaft **14** is inserted into a bearing section **30** on the frame **1***b*.

Idler pulleys **21**, **22**, **23** and **24** are provided near both rails **10** and **11**.

One end of each of wires **25** and **26** are fixed to the side wall of the frame **1***b*. The wire **25** is put on the double grooved pulley **12**, the idler pulley **21**, then wound few turns around the wire pulley **15**, and put on the idler pulley **22** and the double grooved pulley **12**. The other end of the wire coming through spring **27** is fixed to the frame **1***b*. One ends of the first carriage **5** and the second carriage **7** are fixed between the idler pulley **22** and the double grooved pulley **12**.

Similarly, wire **26** is put on the double grooved pulley **13** and the idler pulley **23**, then a few turns of the wire **26** are wound around the wire pulley **16**, and put on the idler pulley **24** and the double grooved pulley **13**. The other end of the wire coming through spring **28** is fixed to the frame **1***b*. Other ends of the first carriage **5** and the second carriage **7** are fixed between the idler pulley **24** and the double grooved pulley **13**. Thus, the two carriages **5** and **7** are supported by wires **25** and **26** passed over the idler pulleys **21**, **22**, **23** and **24**. The idler pulleys **21**, **22**, **23** and **24** function as pivots for the carriages **5** and **7**.

The wire pulleys **15** and **16** are rotated by the driving force of the stepping motor **18**. Since the wires **25** and **26** are wound around the wire pulleys **15** and **16** respectively, the wires **25** and **26** move as the wire pulleys **15** and **16** rotate. Since the carriages **5** and **7** are fixed to the wires **25** and **26**, the carriages **5** and **7** move as they are pulled by wires **25** and **26** when the wires **25** and **25** move. The ratio of moving speeds of the first carriage **5** and second carriage **7** in the secondary scanning direction A (see FIG. **2**) is 2:1

How the surface of the copy paper is read (reading operation) will be explained next with reference to FIG. **2**. The copy paper (not shown in the figure) is mounted on to the contact glass **2**. The two carriages **5** and **7** are positioned first in the home position, i.e., the position shown in FIG. **2**. The two carriages **5** and **7** are then made to move with the ratio of moving speed 2:1 towards the right direction (i.e., the secondary scanning direction A). While the two carriages **5** and **7** are moving, the light from the illuminating lamp **4** is illuminated on the copy paper. The light reflected from the surface of the copy paper falls on the mirrors **3** and **6**. The light reflected from the mirrors **6** passes through the forming lens **8** and falls on the CCD **9** where an image of the surface of the copy paper is formed.

Detailed explanation of the bearing section **30** into which the other end of the drive shaft **14** is inserted will be given now. FIG. **5** shows the longitudinal side view of the bearing section **30**. The bearing section **30** is composed of a bearing hole **31**, a bearing **32**, and a crimp member **33** inserted between the bearing hole **31** and the bearing **32**.

The bearing hole **31** is made by cutting a notch in the frame **1***b* of the image reader **1**. The shape of the bearing hole **31** is that of a circle made flat at the top and bottom as shown in FIG. **6**.

The bearing **32** has a flange **32** on one end of the bearing main body **32***b* which has an insertion hole **32***a* for inserting the drive shaft **14** as shown in FIG. **7**A and FIG. **7**B. The outer shape of the bearing main body **32***b* is almost same as that of the bearing hole **31**, and the bearing main body **32***b* is little smaller than the bearing hole **31** so that the bearing main body **32***b* fits into the bearing hole **31**.

The crimp member **33** is made up of elastic material in the form of thin sheet like plastic as shown in FIG. **8**. This crimp member **33** is made of the roughly ring shaped ring **33***a* which allows the insertion of the bearing main body **32***b* of the bearing **32** and two protrusions **33***b* positioned symmetrically protruded from ring **33***a* towards the center.

Going into further details, these two protrusions **33***b* are the interfering portions that interfere with the bearing **32** and they are placed in positions to interfere with the bearing main body **32***b* of the bearing **32** which is inserted into the hole **33***c* in the crimp member **33**.

After superposing (or sticking) the crimp member **33** on the bearing hole **31**, the bearing main body **32***b* of the bearing **32** is fitted into the bearing hole **31** and inside of the crimp member **33** as shown in FIG. **9**A. The flange **32***c* is pressed against the frame **1***b* through the ring **33***a* of the crimp member **33**. As a result, the two protrusions **33***b* of the crimp member **33** get bent as shown in FIG. **9**B, as they are pressed by the bearing main body **32***b* of the bearing **32** inserted inside. Thus, since the crimp member **33**, which is made of thin sheet of elastic material, is bent after being pressed by the bearing main body **32***b* of bearing **32**, it is pressure welded resiliently to the flat portion of the bearing main body **32***b* of bearing **32**. Thus, even if there is a small gap between the bearing hole **31** and bearing **32**, the bearing **32** will not rattle because the crimp member **33** will suppress any rattle. The bearing **32** can be crimped firmly in the bearing hole **31** because of the two protrusions **33***b* provided symmetrically with respect to the bearing **32**. It is needless to say that the drive shaft **14** is inserted into the inserting hole **32***a* of the bearing **32**.

In the conventional bearing section **200** (see FIG. **10**), the rattle is caused in the axial and radial of the drive shaft **14** if the gap between the bearing **32** and bearing hole **31** is wide. However, according to the embodiment of the present invention, the rattle in the axial and radial of the drive shaft **14** is not caused because of the provision of the crimp member **33** between the bearing **32** and bearing hole **31** thereby crimping the bearing **32** in the bearing hole **31**. Since there is no rattle, there will be no impulsive sound at the time of start up and stop, noise during normal operation caused due to the load exerted while driving. In addition, there will be no decline in driving efficiency or decline in durability.

Due to the interference of protrusions **33***b*, made of elastic material in the form of a thin sheet of crimp member **33**, positioned at right angle face with respect to the axial of the drive shaft, with the corresponding bearing **32** when the bearing **32** is fitted into the bearing hole **31**, the bearing **32** is made to crimp in the bearing hole **31**. This is aimed at simplifying the assembling of the crimp member **33** with the bearing **32** and fabrication of the crimp member **33**.

It was assumed in this embodiment that the image formation section **103** employs the electrophotographic system. However, it is by no means limited to this. For example, the image formation section **103** may employ a printing method that is employed in the ink jet printers, thermal sublimation, the silver halide photography, direct thermal recording method, thermal hot melt printing, etc. The detailed explanation is omitted here, as the specific constitution has been known widely.

According to the bearing structure for drive mechanism of the present invention the bearing is fabricated such that it fits loosely into the bearing hole and a crimp member is provided to crimp the bearing in the bearing hole thereby filling the gap between the bearing and bearing hole. As a result the drive draft does not rattle. This enables to prevent the impulsive sound at the time of start up and stop, noise during the normal operation caused due to the load exerted while driving, decline in driving efficiency (driving performance decrement) and decline in durability.

The bearing structure for drive mechanism of the present invention is used in the image reader of the present invention. Thus, it is possible to have an image reader which is silent, efficient and durable.

The bearing structure for drive mechanism of the present invention is used in the image forming device of the present invention. Thus, it is possible to have an image forming device which is silent, efficient and durable.

The present document incorporates by reference the entire contents of Japanese priority document, 2001-276014 filed in Japan on Sep. 12, 2001.

Although the invention has been described with respect to a specific embodiment for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art which fairly fall within the basic teaching herein set forth.

What is claimed is:

1. A bearing structure for a drive mechanism comprising:

a first hole in a frame;

a bearing member that is fit into the first hole, the bearing member having a second hole for inserting a drive shaft that is driven by a drive motor; and

a crimp provided between the bearing member and the first hole, which crimps the bearing member in the first hole;

wherein the crimp is made of elastic material in the form of a thin sheet, wherein the crimp having

a third hole for inserting the bearing member and the drive shaft;

and at least one interfering portion that interferes with the bearing member when the bearing member is inserted in the third hole.

2. The bearing structure according to claim **1**, wherein there are two interfering portions and the interfering portions are provided symmetrically on opposite side with respect to the third hole.

3. An image reader comprising:

a moving body fixed to two wires;

a drive shaft having two ends, one pulley provided at each end, the wires being wound around the corresponding pulleys,

a motor that drives the drive shaft to thereby realize reciprocating motion of the moving body;

and a frame having two first holes, a bearing structure being fitted into each first hole, each bearing structure having

a bearing member that is fit into the corresponding first hole, the bearing member having a second hole for inserting the drive shaft; and

a crimp provided between the bearing member and the first hole, which crimps the bearing member in the corresponding first hole.

4. An image forming device comprising:

an image reader that scans a surface of a medium to acquire image data of the surface; and

an image forming section that forms and prints an image of the surface based on the image data acquired by the image reader,

the image reader including

a moving body fixed to two wires;

a drive shaft having two ends, one pulley provided at each end, the wires being wound around the corresponding pulleys,

a motor that drives the drive shaft to thereby realize reciprocating motion of the moving body; and

a frame having two first holes, a bearing structure being fitted into each first hole, each bearing structure having a bearing member that is fit into the corresponding first hole, the bearing member having
a second hole for inserting the drive shaft; and
a crimp provided between the bearing member and the first hole, which crimps the bearing member in the corresponding first hole.

5. A bearing structure for a drive mechanism comprising:
a first hole in a frame;
a bearing means fit into the first hole, the bearing means having a second hole for inserting a drive shaft that is driven by a drive motor; and
a crimp means provided between the bearing means and the first hole for crimping the bearing means in the first hole.

6. An image reader comprising:
a moving means, fixed to two wires, for holding optical components for scanning a surface of a medium;
a drive shaft having two ends, one rotating means provided at each end, the wires being wound around the corresponding rotating means,
a driving means that drives the drive shaft to thereby realize reciprocating motion of the moving means; and
a frame means having two first holes, a bearing structure being fitted into each first hole, each bearing structure having
a bearing means fit into the corresponding first hole, the bearing means having a second hole for inserting the drive shaft; and
a crimp means provided between the bearing means and the first hole for crimping the bearing means in the first hole.

7. An image reader comprising:
an image reading means that scans a surface of a medium to acquire image data of the surface; and
an image forming means that forms and prints an image of the surface based on the image data acquired by the image reading means,
the image reading means including
a moving means, fixed to two wires, for holding optical components for scanning a surface of a medium;
a drive shaft having two ends, one rotating means provided at each end, the wires being wound around the corresponding rotating means,
a driving means that drives the drive shaft to thereby realize reciprocating motion of the moving means; and
a frame means having two first holes, a bearing structure being fitted into each first hole, each bearing structure having
a bearing means fit into the corresponding first hole, the bearing means having a second hole for inserting the drive shaft; and
a crimp means provided between the bearing means and the first hole for crimping the bearing means in the first hole.

8. A bearing structure for a drive mechanism comprising:
a first hole in a frame;
a bearing member that is fit into the first hole, the bearing member having a second hole for inserting a drive shaft that is driven by a drive motor; and
a crimp member separate from the bearing member and provided between the bearing member and the first hole, which tightly crimps the bearing member in the first hole, whereby the bearing member is prevented from rattling.

9. The bearing structure according to claim **8**, wherein the crimp member comprises a ring portion and a protrusion extending from an inner portion of the ring portion.

10. The bearing structure according to claim **9**, wherein the protrusion extends within the first hole whereby the protrusion is provided between the bearing member and the first hole.

11. The bearing structure according to claim **8**, wherein the crimp member comprises a ring portion and a plurality of protrusions extending from an inner portion of the ring portion.

12. The bearing structure according to claim **11**, wherein the plurality pf protrusions extend within the first hole whereby the plurality of protrusions are provided between the bearing member and the first hole.

13. A bearing structure for a drive mechanism comprising:
a first hole in a frame;
bearing means that is fit into the first hole, the bearing means having a second hole for inserting a drive shaft that is driven by a drive motor; and
means for crimping provided between the bearing means and the first hole, which crimps the bearing means in the first hole;
wherein the means for crimping is made of elastic material in the form of a thin sheet, wherein the means for crimping includes
a third hole for inserting the bearing means and the drive shaft;
and at least one interfering portion that interferes with the bearing means when the bearing means is inserted in the third hole.

14. A bearing structure for a drive mechanism comprising:
a first hole in a frame, the first hole being non-circular in shape;
a bearing member that is fit into the first hole, the bearing member having a second hole for inserting a drive shaft that is driven by a drive motor; and
a crimp member provided between the bearing member and the first hole, which tightly crimps the bearing member in the first hole, whereby the bearing member is prevented from rattling.

15. The bearing structure according to claim **14**, wherein the bearing member has an outer surface that has a shape that is identical to a shape of the first hole.

16. The bearing structure according to claim **14**, wherein the first hole has a circular portion and a flat portion, and wherein the bearing member has an outer surface with a circular portion and a flat portion.

17. The bearing structure according to claim **16**, wherein the crimp member comprises a ring portion and a protrusion extending from an inner portion of the ring portion, and wherein the protrusion extends within the first hole between the flat portion of the bearing member and the flat portion of the first hole.

18. The bearing structure according to claim **14**, wherein the first hole has a first circular portion, a first flat portion, a second circular portion, and a second flat portion, and wherein said bearing member has an outer surface with a first circular portion, a first flat portion, a second circular portion, and a second flat portion.

19. The bearing structure according to claim **18**, wherein the crimp member comprises a ring portion, a first protrusion and a second protrusion, wherein the first protrusion and the second protrusion extend from an inner portion of the ring portion, wherein the first protrusion extends within the first hole between the first flat portion of the bearing member and

the first flat portion of the first hole, and wherein the second protrusion extends within the first hole between the second flat portion of the bearing member and the second flat portion of the first hole.

20. The bearing structure according to claim **14**, wherein the crimp member comprises a ring portion and a protrusion extending from an inner portion of the ring portion.

21. The bearing structure according to claim **20**, wherein the protrusion extends within the first hole whereby the protrusion is provided between the bearing member and the first hole.

22. The bearing structure according to claim **14**, wherein the crimp member comprises a ring portion and a plurality of protrusions extending from an inner portion of the ring portion.

23. The bearing structure according to claim **22**, wherein the plurality pf protrusions extend within the first hole whereby the plurality of protrusions are provided between the bearing member and the first hole.

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